LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – PHYSICS

FIRST SEMESTER – NOVEMBER 2018

16/17/18PPH1MC04/PH 1820 – MATHEMATICAL PHYSICS - I

Date: 01-11-2018 Dept. No. Max. : 100 Marks

Time: 01:00-04:00

PART A

Answer all the questions 10 x 2 = 20 Marks

1. Write the algorithm of Runge-kutta method of solving 2nd order differential equations.
2. Sketch the graph $y = \sin 5x$.
3. What are equipotential surfaces? Write its characteristic equation.
4. Show that $e^{i\alpha}$ is an operator.
5. Find the norm of $(1,3,-5)$ in R^3 with standard inner product.
6. Define the terms positivity and point of symmetry of vector spaces.
7. Obtain an expression for $P_2(x)$ where 'P' stands for Legendre polynomials.
8. Define Hankel's functions.
9. Prove that $\delta_j^i \delta_k^j = \delta_k^i$
10. State Hooke's law.

PART B

Answer any four questions 4 x 7.5 = 30 Marks

11. Compute the real root of $x\, log_{10} x - 1.2 = 0$
12. Derive Cauchy-Riemann conditions for a function to be analytic.
13. Show that the vectors u and v of a Euclidean space are orthogonal if and only if $\|u+v\|^2 = \|u\|^2 + \|v\|^2$.
14. Evaluate $\int_0^{\frac{\pi}{2}} \frac{1}{\sqrt{\tan\theta}} d\theta$ using the knowledge of special functions.
15. i) Show that the sum of two tensors of the same order and type is again a tensor of the same order and type as the given tensor.

    ii) Show that a symmetric tensor of the second order has only $\frac{n(n+1)}{2}$ different components.
16. Using, Newton-Raphson method, evaluate $\sqrt{18}$.

PART C

Answer any four questions 4 x 12.5 = 50 Marks

17. Find the root of the equation $2x - log_{10} x = 7$, using Newton – Raphson method.
18. State and prove Cauchy's theorem.
19. Let v be the vector space of all polynomials in an determinate x, over the real field R of degree atmost 2. In v, if we define inner product by $f(x), g(x) \in v \;\; as \;\; < f, g >= \int_{-1}^{+1} f(x)g(x)dx$ starting from $1, x, x^2$ of v obtain orthonormal basis.
20. Derive any three recurrence relations of Legendre polynomials.
21. Find the components of Euclidean metric tensor and obtain the expression for the line element in cylindrical coordinates.
22. Evaluate $\int_0^{2\pi} \frac{d\theta}{13+5\,sin\theta}$ using contour integration.

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